SPECIAL REPORT



The RISE of BIOPESTICIDES

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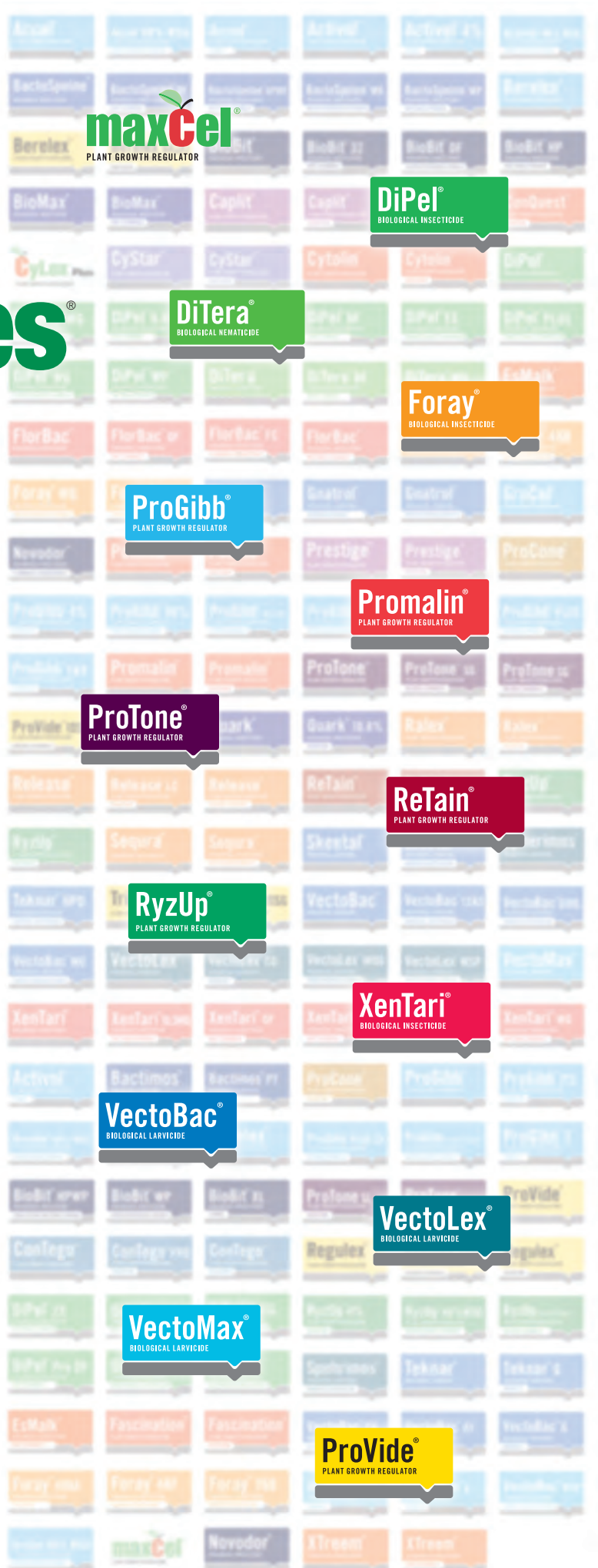

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The Rise of Biopesticides

The best journalists always have an ear to the ground and an eye down the road. They're always aware of what their audiences are talking about, always on the lookout for that trend with the potential to foreshadow dramatic change.

Such was the case when the topic of biopesticides began to crop up with increasing frequency among our editors. It began to take on all the elements that make for a compelling read: high-level implications across multiple audiences and for multiple levels of the food value chain, sustained growth and accelerating adoption within an emerging area of technology, and an underlying controversy about which way the prevailing winds were headed.

As we began to dig into the topic of biopesticides for this Special Report, it became clear that what we were investigating was likely more than just a trend. What we found was that demand for biopesticides — and the forces that drive it — is a convergence of far-reaching internal and external factors that might better be defined as an inflection point than simply a subtle change in agricultural currents.

Inflection Point — "What happens to a business when a major change takes place in its competitive environment. A major change due to introduction of new technologies. A major change due to the introduction of a different regulatory environment. The major change can be simply a change in the customers' values, a change in what customers prefer." — *Andy Grove, Intel Corp.*

At its nexus, increased interest in biopesticides is being driven by two irresistible market forces: the need to feed a rapidly growing world population and the deceivingly complex notion of sustainability. This much we knew going in, and on the surface seemed to grant biopesticides the proverbial "no-brainer solution" status. But then our research revealed another layer of lesser-known factors, factors that have long undermined the adoption of these products and have long-rendered biopesticides to secondary status in the mainstream grower's mind.

Beneath the familiar, long-held debates about efficacy and product viability, behind the advocate's cry for sustainability and responsible farming, we discovered that biopesticide adoption included a complex mix of social, economic, and political elements that make it a seminal topic for any grower/shipper, researcher, consultant, ag retailer, or even food retailer that plans to do business for the long haul.

Of course, it's our job to make sure you're in a position to evaluate the import of these issues on your own. So we've devoted the next 24 pages (and a special webpage at www.riseofbiopesticides.com) to an exploration of what these technologies mean for you and what they mean for your customers, to how consumer trends, regulatory agencies, and the almighty dollar are shaping the competitive landscape for biological products and the end users they target.

We hope you'll join us now as we take a detailed look at what's behind the Rise of Biopesticides. ■

Rick Melnick
Corporate Editorial Director,
Meister Media Worldwide

INSIDE THIS REPORT

The RISE of Biopesticides is a series of five articles that explores biopesticide adoption from a variety of perspectives throughout the food value chain.

MORE ONLINE: Want to do a little research on your own? We've assembled a database of information from biopesticide field trials from a variety of research organizations. Find out more at www.riseofbiopesticides.com.

Biopesticides: Performance, Promotion, and Politics

The market outlook is suddenly bright for the biopesticide industry. But the fact that a product has value doesn't always guarantee its success.

By Rick Melnick

There's been an undeniable buzz circulating about biopesticides lately. But that's not really a first. In the early 1980s, *Bacillus thuringiensis* (*Bt*), still the most used biopesticide in the world, had already demonstrated value in the field and had gained widespread acceptance in the marketplace. And once *Bt* put forward the possibilities, there was a lot of excitement in agriculture about what the future might hold for biological products.

Unfortunately, things didn't quite pan out the way many biopesticide advocates were hoping. The term "snake oil," that disparaging moniker that makes every input supplier cringe, began its ill-fated association with the category.

Dimock

Mike Dimock, director of field development and technical services for Certis, was just coming out of graduate school then and remembers it well.

"Obviously, there was a lot of overpromising and underdelivering," Dimock says of biopesticides 30 years ago. "The way to succeed back then was to do enough research to get something patented and then start talking to the venture capitalists. The most important thing then was your exit strategy: Who are you going to sell your idea to a year or two down the road."

Many of the bright ideas of the day simply couldn't transfer to the field. The market, however, has a way of sorting itself out. Biopesticides that were commercially viable wound up having staying power. The ones that didn't, went away. One of the key drivers in the resurgence of biopesticides (a.k.a. biologicals or biorationals) is that the surviving technologies have now had time to reassert themselves by bringing demonstrable value to the market. Add a mix of consumer preferences and regulatory pressures and you have the recipe for a rise.

Combination of Factors

There's no doubt that external factors are playing a key role. Marcus Meadows-Smith, CEO of AgraQuest, says the steady growth the industry is experiencing has been due to a combination of influences.

"I think perhaps three years ago the drivers really started to build," he says. "It was a growing confidence and acceptance that our products have a right to play in the market — that they are adding efficacy and yield to conventional spray programs. Then another language started to come in around sustainability — around the environment and the fact that the experts are

BIOPESTICIDE VALUE: THE SUM OF THE PARTS

The rate of biopesticide adoption relates directly to market acceptance of their use within an integrated program. Some key benefits that biopesticides offer:

- Crop Quality and Yield
- Maintaining Beneficials
- Labor and Harvest Flexibility
- IPM Compatibility
- Resistance Management
- Environmental Safety
- Residue Management

Source: Biopesticide Industry Alliance

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predicting we're going to have to feed nine billion people. That's a change."

Indeed, the emphasis on sustainability may be the best thing that's ever happened to biopesticides. Pam Marrone, CEO of Marrone Bio Innovations, puts it right at the top of the list of market drivers.


Marrone

"Take a look at Big Food in the U.S.," says Marrone, "Sysco, Walmart, McDonalds — all these companies. Whether it's pressure from shareholders or from consumers, they're all putting in place sustainability programs. They just can't use as many chemicals as they once did."

While the green movement is a factor, however, Marrone and her biorational peers have no illusions about what's most important for the success of their products.

"Bottom line, the products have to perform," she says. "What hasn't changed is the number-one reason a customer uses a product: because it has value. Because it performs at a cost benefit ratio that helps them with their business. What *has* changed is that today they will look at a biopesticide and choose one, where in the past they might not have ever even thought about using one."

Changing the Grower's Mind

Valent BioSciences Corp. President Mike Donaldson says that companies being more responsible about making claims and more stringent in the testing of their products, is a key growth driver for biopesticides. He also says today's grower cares less about how a product is categorized, and cares more about the full value proposition that biorational products bring.


Donaldson

"The efficacy has to be a given, but today growers are much more sensitive to the issues of residues and non-target activity," Donaldson says. "Obviously resistance management is very important to them. But they don't differentiate so much as to whether it's a biopesticide or a traditional chemical — it's not an either/or. Now they're looking at the total value — often as partners in a program."

Donaldson also notes that the introduction of softer, conventional chemistries has only helped the biopesticide industry. He says that in many ways, the softer chemistries are helping to raise awareness on the value proposition that biopesticides have been promoting all along.

"Growers 20 years ago had a broad spectrum, sometimes harsh, chemical product and a biopesticide," says Donaldson. "Today, there's more options with traditional chemistry that have a more narrow spectrum of control. Those chemistries are raising the bar on biopesticides, which is actually good. It's no longer you and an OP [organophosphate]; now it's you and a softer chemical. The grower better understands the value now, and confidence in biopesticides is increasing."

Dimock points to acceptance of plant health benefits as another important element of change. He's also quick to state, however, that those same benefits were often a contributor to lack of grower and researcher confidence.

"A big thing now is there's so much focus on soil implied materials and induced resistance. Five or six years ago that was almost like voodoo. You apply this stuff and the plants look more healthy or more vigorous and we weren't really sure how. But now the science has really filled in behind that. We have a lot more ability to explain — in terms of chemical pathways what's going on in the plant response."

Meadows-Smith also points to plant health benefits as being a critical step forward.

"Not only can the best biopesticides stand shoulder-to-shoulder with synthetic pesticides in terms of efficacy, sometimes we are head and shoulders *above* the conventional when it comes to yield increase. It's not a 3% increase that might be difficult to detect, but it's a visible plant health effect that when the agronomist or the PCA (pest control advisor) walks the field, they can literally see the difference."

Limiting Factors Remain

Bill Stoneman is Executive Director for the Biopesticide Industry Alliance (BPIA), the domestic trade association representing biopesticide manufacturers and allied industry. Stoneman points to the growth of BPIA — from 32 members in 2008 to 60 members in 2011 — as a clear indicator of where the market is headed.

Despite all the positives, however, challenges for biopesticides remain. Stoneman says that the shift toward use of biopesticides in a program — the key selling point for these products — will take time yet to sink in. An agronomist by trade, Stoneman has seen the industry be slow on the uptake before.

"When a new conventional chemistry is introduced, there's typically a substantial marketing and demonstration effort all the way down to the county level," Stoneman says. "That means the smaller companies have to go out and demonstrate a product to prove its value just like the big boys do. I can remember when Roundup came out back in the late '70s to early '80s — nobody wanted to buy it because they didn't see a fit for it in their production system," Stoneman chuckles. "Look how that turned out."

The issue of critical mass and available resources for smaller companies is a very real challenge for biopesticide companies. Diana Horne is senior biologist with EPA's Environmental Stewardship Branch. For the last seven years, Horne and others at EPA have been partnering with USDA/IR-4 on a demonstration grant program to help biopesticide companies connect with growers, and to help growers gain real-world experience with biopesticides.

"We saw early on with the biopesticide companies being so small that they weren't able to have the face time with extension or have field contact with the growers," she says. "We knew this was hap-


Larose

pening and that we needed to throw some money at it in order to get researchers even interested in trying some of these products."

While the program proved successful and funding started out strong, it has since been a victim of budget cuts. Donaldson says that while it's unfortunate, it's really not up to the government to bring products to market.

"As an industry we can describe the problem, but the question simply becomes — what are you going to do about it? I think the answer is that companies can't rely on their channel partner to do the development for them, and they can't rely on key influencers to do it either. Bottom line, you have to have the critical mass — the Ph.D.s, the plant physiologists, the staff that many of these companies can't afford. At the end of the day, to be successful, you've got to take control of the development process and see these products all the way through to commercialization yourself."

Rob Larose is president of BioSafe Systems, which specializes in biopesticide products used as bactericides/fungicides. He agrees that market penetration for a small company can be a challenge, but it's one that has to be embraced if the company wants to be successful.

"We've accepted that education is a factor and we need to work more directly with our growers — and then leverage that experience," he says. "With the universities, it's no secret that the larger companies tend to dominate those institutions and facilities. They don't leave the door open for other people to walk in there, whether you're a biopesticide or you're a conventional product. For a little company, it's kind of hard to break into a big institution and get their attention. So you do what you can."

All things considered, there's no arguing with the numbers. Most estimates indicate the biopesticide market has tripled since 1995, and that growth has been accelerating for the last ten years. So what's next?

Donaldson says that technology is what the industry needs most. "I see existing products continuing to grow in the high single digits and low double digits. There's still a lot of growth left in these products through label expansion, geographic expansion, formulation improvement. Beyond that, finding new technology is the key." ■

EFFICACY ISN'T ALWAYS ENOUGH

The research and extension community isn't the only nut that can be tough to crack. Massive food companies, who control their own pests management programs from start to finish, can be even more difficult for small companies to penetrate.

Consider the following example: Black Sigatoka is widely regarded as the bane of banana producers. A leaf spot disease caused by the fungus *Mycosphaerella fijiensis*, Black Sigatoka can spread quickly and literally ravage a banana crop. As a result, a banana plantation can receive as many as 60 or 70 fungicide applications per season.

Enter the biopesticide Timorex Gold (tea tree oil), a plant extract of *Melaleuca alternifolia*, a native of Australia. Developed and marketed by the Stockton Group, Timorex Gold has been highly researched and has demonstrated powerful antiseptic and antifungal qualities for control of powdery mildews, downy mildews, rust and early & late blight diseases. Because of its residue exemption, Timorex has become an important tool for early adopters amongst Latin American fruit and vegetable growers, especially those exporting to the U.S. The product is in the process of registration in U.S. and Canada.

Trial results for Timorex Gold show strong preventative and curative properties against Black Sigatoka - a quality that makes it seem like a natural fit for banana producers. Add the sheer number of fungicide applications bananas receive and the resistance management benefits of the biopesticide, and the solution seems like a no-brainer.


Tirosh

But as many small companies like Stockton find out, having an innovative and effective solution isn't always enough. Just gaining access to the right people at a huge company like Chiquita or Dole can be extremely difficult. Consider how many input suppliers are knocking on the door of Chiquita, a company that reported more than $2.1 billion in banana sales in 2009 alone.

Stockton President Peter Tirosh says that while product has yet to gain traction with the big boys, its success with smaller banana producers keeps him thinking positive thoughts.

"We just have to accept that these big companies have their own way of doing things - their own timelines," Tirosh says. "We remain confident that when the time comes, our product will bring them great results. Until then, we will keep expanding into new markets and meeting the significant demand that already exists."

Biocontrols help solve re-entry issues and allow strawberries to be picked semiweekly.

Turning Challenges Into Opportunities

Consultants and PCAs have long been seen as a barrier to biopesticide adoption. But times are definitely changing.

By K. Elliott Nowels

Fruit grower Wayne Brandt of Brandt Farms near Reedley, CA, wants to make sure the strength of his integrated pest management effort matches his desire to produce high-quality, late maturity fruit. That's one reason that today he's got his pest control advisor (PCA), Karl Warkentin, in his conference room.

In the course of conversation, Brandt is stressing his desire to use a "softer approach" to controlling pests early and often — before "constant hatch." It's an approach that includes the use of biopesticides — *Bacillus thuringiensis* to be specific.

Like any consultant worth his salt, Warkentin is keen on serving his client. But you can see him fidget just a bit. He knows what that "softer approach" will mean to his schedule in the coming days.

"The soft approach means more checking. You have to be more thorough," says Warkentin. "You've got to slow down and check things. It means more sets of eyes." Warkentin agrees there is value to this path but can't suppress a chuckle as he compares the soft approach to the blanket chemical approach that he describes as "the PCA's friend."

The scene is being played out more often across the United States as niche markets for fruits and vegetables gain share, organics rival conventionally grown produce and older, more toxic chemistry is banned.

Field Level Needs

At field level, growers are looking for bug-free, damage-free, high yielding crops to give them a predictable advantage in a variety of markets. They are seeking a softer approach, but only to a point. Pests can't be tolerated, but neither can residues. In the midst of this effort to meet consumer demand, consultants are finding their already complex job becoming, well, more complex.

"Let's face it, this is our job," says Dr. Charlie Mellinger of Jupiter, FL, in a kind of verbal shrug. "Our (Florida) growers ship all over the world and it's our responsibility as consultants to help them produce a crop that meets the specific needs of the market they are growing it for."

Mellinger, a past officer of the National Association of Independent Crop Consultants is co-owner, of Glades Crop Care with his wife Madeline. He sees a definite rise in biopesticide use. While consumer demand is factor, Mellinger also stresses worker safety and resistance issues as being key drivers.

Fruit grower Wayne Brandt (left) meets with pest control advisor Karl Warkentin about his integrated pest management.

But not all consultants share Mellinger's view. Many still wrestle with issues that have plagued biopesticides in the past — among them, efficacy, ease-of-use, and the fact that they're just plain different.

To Mellinger, this creates way more opportunity than problem.

"It's a fantastic time to be a crop consultant," he says. He points to the increased complexity of growing produce as something that makes quality information more valuable.

"It's more technical and growers are more interested in the kind

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of first-hand analysis and recommendations we can provide," he says. He points to nematode control as an example of an approach that's more integrated and precise.

"When we could use methyl bromide on every acre, it wasn't a problem," he says.

Mellinger explains that education and technical information delivered to clients is an important part of their consulting business.

"I definitely think that it's a competitive advantage for us," he says. "Growers are looking for help and we can provide it. We also have research farms where we also are learning about the characteristics of these new products firsthand."

Using All The Tools

Over near Oxnard, CA, consultant Jim Reiman of AGRX studies a plant at the edge of a celery field as an application rig moves through the field behind him.

"For us, IPM (integrated pest management) simply means using all the tools available to us, whether it's beneficial insects, *Bts*, or some of the softer chemistry," Reiman says.

Biopesticides are especially helpful in solving re-entry issues for harvest time and that alone makes them crucial to his work.

"Harvesting strawberries twice a week, we don't have a lot of time to get an application done," he explains. "Consequently you don't have a lot of preharvest interval (PHI)," Reiman says. "With the PHI on most of the biopesticides being basically zero, that's extremely helpful."

Reiman says his clients want flexibility after harvest, too.

"*Bt*s are very helpful with the MRLs (maximum residue levels)," says Reiman. "Growers will have more flexibility with the produce when there are no barriers to shipping that other products might carry with their use."

More scrutiny from consumers brings more scrutiny from produce buyers. The oversight must move to field-level to satisfy the demand.

"A lot of retail chains are demanding food safety and quality certifications which we are performing for them," says Max Jehle, a consultant in California. "That means we must follow standards and metrics that will help eliminate or reduce the amount of pesticide residue that we have on our crops."

Jehle says the fruit company he works for has a program that field tests for pesticide residues — whether it's organic production or not. If the crop has a residue above tolerance, then it won't be harvested.

"This is to ensure that we can show our retailers that our fruit is below tolerance or has no pesticide residue whatsoever," he says. "So consumer preference, or consumer demand, or market-chain demand — whatever you want to call it — is very much in the picture."

Pest control advisors also have to help growers understand that control of pest populations with an integrated pest management approach reliant on biopesticides will look different than a conventional pesticide.

"Yes, the grower has to accept what the product is," explains Dr. Gary Liebee, a Florida research scientist. Liebee says the learning curve with many biopesticides comes because growers have to adjust their thinking to a different kind of effective control.

Broc Zoller, or "The Pear Doctor" to many, works to balance many needs in his service area of Northern California. Mating disruptors (pheromone confusion technique) have found a place in his control of codling moth, a principal pest of pears and apples.

Zoller says he is using mating disruption in both conventional and organic settings throughout his service area, and augments that control with materials, such as Intrepid and Altacor in conventional settings — and Entrust with organics. *Bt*s are cycled in when weather is favorable. He says he's always looking for new products to provide additional solutions that help avoid resistance.

"I've seen a lot of tests and advertising of biologicals and remain hopeful," he says. ■

Editor's note: K. Elliott Nowels is journalist who has been covering agriculture for more than 30 years, and is a Vice President at Meister Media Worldwide.

BIOPESTICIDES MAKING INROADS WITH FIELD CROPS

While biopesticides are best known for use on specialty crops, they're starting to impact row crops as well. Consultants and their growers are working with several biopesticides that display strong plant health and yield benefits through a variety of actions.

Peterson

Scott Peterson manages the biological product portfolio for SipcamAdvan, including the biofungicide Contans (*Coniothyrium minitans*). Contans has been garnering a lot of attention for its excellent control of white mold on soybeans, edible beans, canola, and sunflower. Consultants are playing a key role.

Peterson admits that in the past, biopesticides weren't the first solutions that came to mind for the consultant.

"Basically, there has to be a situation where something is not working on the farm and they have to try other options. And because of the strength of the chemical industry, they'll usually exhaust all options with conventional chemicals first," Peterson says. "But that's just because a lot of them have been trained to think that way. It doesn't mean they're not trying to do the right thing for the grower, it's just when you've been trained on conventional pesticides, that's what you lean toward first.

"More recently, as biologicals have gained market access and market share, consultants are starting to look into the use of biologicals. If a product has demonstrated efficacy, they'll use it. Ultimately, they're just trying to help solve their growers' problems."

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Stocking The Shelves

Hungry for products that will differentiate them from the pack, traditional ag retailers are an effective route to get biopesticides in the hands of growers.

By Paul Schrimpf

At Wilbur-Ellis' Grant, MI research plots, biopesticide products are thoroughly tested, and the results are shared with growers during summer field days.

For the past decade, the ag distribution channel has been rocked by seismic changes that have occurred in U.S. agriculture. Biotechnology started it all, stripping billions of dollars in traditional insect and weed control application out of the market. In recent years, wild swings in fertilizer prices and grain stocks have further stressed the channel. The result has been sweeping consolidation in the ranks.

According to ag retailer publication *CropLife*® magazine, which annually conducts its "*CropLife 100*" survey of the 100 largest retail organizations in the U.S., the six largest providers of agriculture chemicals command 63% of the total *CropLife 100* revenue, and almost 85% of *CropLife 100* revenue is generated by companies earning $100 million or more annually.

Today, the retailers that have survived are leaner, more competitive, and driven to differentiate themselves from the pack — and that includes the product mix retailers are stocking and selling.

Biopesticides have the potential to fit the bill on this front for a number of reasons. Growers are feeling increasing pressure to reduce residues downstream, from food processors all the way down to the nation's largest food retailer, Walmart. There's a recognition that efficiencies can be gained when products with a relatively rapid reentry time allow for a speedier harvest with no negative consequences to food quality. And there's a growing awareness beyond organic that managing pest complexes with highly targeted products is vastly superior to the many "nuclear options" that create ecological disruptions beyond the target pest, and that often lead to the need for repeated sprays and an increased risk of resistance.

Coincidentally, biopesticides manufacturers have evolved over the past decade as well. From generally humble beginnings, companies that have survived or emerged today have improved manufacturing processes and sell products with more consistent performance and formulations. And they have embraced the distribution channel where it matches closely with the markets they wish to serve — meaning conventional, not just organic, acres.

"We actually work hard at *not* getting our products put into an organic bucket," says Chris Hildreth, senior vice president of Commercial Operations at Marrone Bio Innovations. "We focus on commercial agriculture, which accounts for about 90% of our sales, and about 60% of the product sold is used in combination with traditional crop protection products." Marrone channel partners are key distributors in traditional crop protection, including companies like Helena and CPS, he adds.

Collaborative Approach

It has not been easy for many retailers to make the adjustment, because incorporating biopesticides takes commitment, knowledge, training, and a different mindset. It also requires a more substantial relationship both with the manufacturer and with the grower. For their part, biopesticide manufacturers have had to learn what it takes to bring targeted, efficacious solutions that retailers can make their own. But the substantial growth potential in

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biopesticides increasingly bring the two sides closer together.

Broader acceptance of biopesticides at the early stages by the retail community was strongest in the specialty crop growing areas, mostly because many of the key early biopesticide products were geared toward higher value specialty crops. By comparison, the development of cropping strategies for biopesticides was still relatively slow, but progressive retailers, consultants and growers dedicated to making them work have kept at it.

Case DeYoung, branch manager of the Wilbur-Ellis outlets in Sparta and Grant, MI, services a customer base that grows predominantly fruits and vegetables. He started with two of the earliest innovations: the *Bt* insecticide DiPel in the late 1980s for control of oblique banded leaf rollers, and codling moth virus.

"In those days we were using products like Lannate — hard pesticides that were not very IPM (integrated pest management) or biologically friendly to beneficial insects," says DeYoung. "And frankly, the traditional chemistries were starting not to work for us." Growers had to rely on frequent spraying of harder chemistries, eating into the efficiency and economy of taking a broad spectrum approach. For DeYoung and his organization, the time was ripe for finding and developing new pest control products and methods — but getting there was not a slam dunk.

"Some of the first biopesticides I had interaction with were fairly specific to one pest, which we were not used to," says DeYoung. "We were used to using broad-spectrum products, and here you had something that might only kill codling moth." It took learning a whole new approach to cropping, such as understanding the impact of degree days on product efficacy, trapping and monitoring insect populations, reviewing university research, and conducting internal research for DeYoung to effectively integrate some of the early biopesticides.

Businesswise, the dedication has paid dividends. DeYoung feels he's among the leaders in his region as an integrator of biopesticide products and is always open to trying out new active ingredients and innovations. Getting there was a challenge, but he's built on his experiences year over year and established what he feels is a solid and proven protocol for testing and integrating new products.

Manufacturers agree that getting the retailer deeply involved is paramount to making biopesticide approaches workable. But they also agree it has been a challenge. BioWorks has established a strong presence in the greenhouse market with its *Trichoderma harzianum* biofungicides. President and CEO Bill Foster says that connecting with, and educating, dealers and distributors is an ongoing challenge for small companies like theirs.

"We realize we'll never be a Syngenta or a Valent," Foster says. "We're not going to be able to command the level of responsiveness that a larger company can. So we feel like if we can get one out of every five distributor sales people comfortable with selling our products, that's not bad. We accept that we still have to spend a lot of our time connecting with the end user and creating demand."

"There are actually a lot of similarities between the retailer relationship with traditional crop protection companies and companies like ours," says Tim Damico, executive vice president, NAFTA at biopesticide manufacturer Certis. Damico agrees that for biopesticide companies, educating the channel is just part of the deal. "It's just a lot more hands on. It requires more training and more detailed knowledge of the product throughout the organization." The way biopesticides work is often simple to understand, he adds, but they can be more complex to use.

Making It Work

The difference between cropping with traditional products and biopesticides is in the degree of intensity. Many of the same practices retailers follow in a traditional setting still apply, but the discipline and attention required can be significantly higher.

Manufacturer collaboration is absolutely critical for getting all facets of the retail operation up to snuff on a product, from how and when the product is used to how it fits in the retailer's marketing plan for the season, says DeYoung of Wilbur-Ellis. Conversations, extensive winter meetings and training sessions in addition to research are critical.

"We feel like if we can get one out of every five distributor sales people comfortable with selling our products, that's not bad."

– Bill Foster, President & CEO BioWorks, Inc.

In season, DeYoung employs enough scouts to perform weekly checks on fields, especially early in the growing season. "We at Wilbur-Ellis are a high service company, and we hope that's reflected in how we do business," says DeYoung.

The other big factor is research. All potential products are put through a rigorous testing regimen to ensure effectiveness in his area of Michigan against the target pest for specific crops. The intensity of testing varies widely, from small plots to multiple acres, depending on the manufacturer's goal for the particular product.

To facilitate the connection with growers and manufacturers and share the successes and challenges, Wilbur-Ellis has its own 60-acre test plot near the Grant location where in-season field days in July and August drew more than 600 growers in 2010.

DeYoung, himself a former employee in the Michigan Extension system, says the research is necessary because Extension is struggling with limited resources and simply not able to keep up. Trevor Thiessen, CEO of manufacturer Novozymes, says that in today's market, retailers provide the best inlet to market opportunities.

"When you have a new technology you can only do so much in small plot trials," says Thiessen. "A good place to learn and understand more is through third-party collaborators, who can get it in the hands of farmers and allow them to test it on their production practices. We can do that effectively through the retail network." ■

Editor's note: Paul Schrimpf is the Group Editor for Meister Media's CropLife Media Group.

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Efficacy Drives Acceptance in IPM

Becker Underwood

Molecular approaches have driven adoption, such as using seed as a conduit for biopesticides.

Better formulations and application technology bolster adoption of biopesticides

By Mike McCue

The steady growth of biopesticides is a fairly recent phenomenon. Experts differ on the exact size of the market, but most estimate that sales have tripled to quadrupled during the last decade. Today, total manufacturer sales are somewhere in the neighborhood of $800 million.

Most expect the upward trend to continue as biopesticides are poised to become an even more critical part of production because they are uniquely positioned to address two seemingly opposing forces: feeding a rapidly growing global population and reducing environmental impact. Proponents of biopesticide adoption would suggest that a solution meeting one of these goals but not delivering on the other simply can't be viewed as sustainable.

Historically speaking, biopesticides have had distinct R&D challenges as well. They're often targeted to a specific pest and geographic area, which can skew the R&D costs by limiting the potential return on investment. Some biopesticides also can be less durable than traditional chemicals compounds, reducing their shelf life or making it necessary to create protective features such as UV screens.

Taking all of these factors into account, there has been plenty of activity in the area of biopesticide R&D. While research will continue to provide new products and improved versions of existing ones, debate continues about whether the current momentum behind biopesticides is more the pull of society or the push of better science.

"It's a definitely a combination of the two," says Marcus Meadows-Smith, CEO of AgraQuest. "The drivers are stronger: There is awareness of the residue issue, and there is awareness of the yield benefits. That will get growers to try a product once. But the right to stay in the market comes only to the products that prove efficacy, robustness and consistency, and I think that's where the industry has made progress in recent years: delivering product with more consistency than was the case in the past."

Meadows-Smith

KEY AREAS OF RESEARCH

With a growing population requiring more food and fiber on a daily basis, research into future biopesticides is being conducted in many areas, including:

- Crop stress management
- Physiological seed enhancement
- Root management
- Plant growth enhancement
- Post-harvest treatments.

Confidence on the Rise

Adding to the popularity of biopesticides has been the continued introduction of new products and technologies, says Bruce Kirkpatrick, senior director of global marketing and business management at Valent BioSciences Corp. (VBC). "Biopesticide development combines specialized disciplines within microbiology, fermentation production, process recovery, formulation, packaging, and application platforms. New technologies from all of these areas have helped improve product performance and value to the grower," he says.

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existing products. Within VBC, Kirkpatrick points to synergies with other biopesticide markets such as forestry and public health.


Kirkpatrick

"Both our agricultural and non-agricultural sectors benefit from technological advancements being made in the other," Kirkpatrick says. In the non-agricultural sectors, key advancements in aerial application equipment, GPS/GIS technology, spray droplet analysis, and formulation optimization have had a significant impact on the overall performance of biopesticides, many of which have been transferable to the agricultural sector.

Whatever success the current market might be experiencing, continued momentum will depend on heavy investments into R&D.

"Research is quite broad across all biopesticide sectors: insecticides, nematocides, fungicides, herbicides, and plant growth regulators," says Pam Marrone, CEO of Marrone Bio Innovations (MBI). "Today, better formulation technology is improving our shelf life, rainfastness and field life. Efficacy studies show it."

Many researchers are quick to add, however, that research has to be conducted with a keen eye toward potential drawbacks as well as potential benefits.

"A lot of factors go into the creation of a biopesticide, from strain discovery to determining whether or not the active ingredient actually kills the pest," says Mike Dimock, director of field development and technical services for Certis. "A lot of that effort is determining how to make the biopesticide in a way that is actually usable by a specific grower."

For spray technology, the decision comes down to the volume growers are applying, the architecture of the crop they're applying it to, and the environment in which it's being sprayed. Most biopesticides are sensitive to sunlight, so they're often formulated or tank mixed with materials that can serve as UV screens.

Soil applications can be even more challenging. Farmers in most developed countries want something that can be applied via drip irrigation, so the product must go through filters, pumps and screens before it is distributed to the field.

"You might not want to dry your product down to a powder; it might be more advantageous to take it right from the fermenter and centrifuge it down to make a liquid concentrate," Dimock says. "Those are the kinds of decisions you make at the very beginning of the R&D process, and many of them are determined by the application method that's being used."

The primary goal in delivery is to minimize product loss, including viability. In field spraying, the relevant performance criteria are canopy penetration, spray retention, spreading, rainfastness, and primary drift.

Location, Location, Location

It's hard to generalize, but most intellectual property in biopesticides is related to industry know-how and trade secrets. With a few notable but rare exceptions, there aren't a lot of patented, blockbuster active ingredients that a company can ride for eight to 10 years, as with traditional chemistries.

And because environmental conditions can vary so widely, the challenges between developed and emerging countries are often more related to product storage under high heat and humidity rather than the application technology, says Michael Braverman, manager of the biopesticide program at Rutgers University.

"Cost and smaller product package size is also a greater challenge to development in emerging countries," he adds. "Within the United States, molecular approaches have greatly enhanced the adoption of biopesticides because they have taken application issues off the table by taking the active molecule out of the organism and enabled protection to develop within the plant. Molecular approaches have also increased adoption by using seed as a conduit for biopesticides."

And new formulation technologies are being explored to improve physical and biological properties, efficacy enhancement, rainfastness, UV protection, storage stability, tank-mix compatibility/stability, residual properties, and improved application properties.

"From a manufacturing perspective, improvements in fermentation inputs, yields and in process recovery for higher efficiencies are producing products with the highest quality and value to the grower," Kirkpatrick says. "To broaden the scope of pests controlled in the traditional area of pest and disease management, new active ingredients that maintain the profile of low-risk and environmental harmony are being evaluated for efficacy against new targets." ■

Editor's Note: Mike McCue is a contributing editor for **Farm Chemicals International**.

KEYS TO BIOPESTICIDE R&D


Reinot

Becker Underwood is among the largest biopesticide companies in the world. Global head of R&D Eda Reinot says proper positioning of biological products will play a huge role in determining their success. "There are no perfect products," Reinot says, "But biological organisms, as well as bioactive and biorational products, offer great promise."

Reinot sees the following as the key innovation drivers for biologicals:

- Potency (the measure of activity versus amount of active ingredient)
- Modes of action complementary to conventional chemicals
- Residual activity (rain fastness, uptake and "systemicity," controlled release)
- User and environmental safety
- Critical Registration Issues (residues, toxicology, delivery to target).

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In Sync with World Demand

Changes in consumer preferences can quickly reshape an industry. Growers and food retailers can either get on board or get left behind.

By Ana Isabel Reho

Ask an average U.S. consumer what a biopesticide is and he will probably shrug his shoulders. Ask a European who is an avid consumer of organic foods why she is paying more for that particular tomato, and she will tell you without hesitation that it's "because it doesn't have any pesticide residues."

The truth is, organic produce in any given country may have high levels of agrochemical traces, while conventional produce may be residue free, provided that during the last stages of the latter's production process a biopesticide-based program was employed.

David Cary, executive director of the International Biocontrol Manufacturers Association (IBMA) agrees that consumers are not well aware of what a biopesticide is. He comments that "IBMA is meeting with food supply chain market groups to make sure the information gets down to the consumer because, once they know, they don't want [chemical] residues in their foods."

In fact, most produce consumers may not be all that familiar with the details of crop production that they value the most. Instead, they must put their trust in government agencies that regulate the approval and registration of agrochemicals as well as its residue levels in food products.

But while regulatory bodies play a vital role, those that rule some food standards are neither consumer associations nor government agencies. The direct responsibility in the food chain often falls to the grower, while the purchase power goes to the retailer.

TOOLS FOR LEARNING

GlobalG.A.P., a private sector body that sets voluntary standards for the certification of production processes of ag products around the globe, has an MRL chapter. One of its tools aims at raising awareness among growers on MRL related issues and provides guidance to help minimize the risk of MRL exceedances [www.globalgap.org].

Trending Now: Residue Focus in Europe

This power game is most obvious in the European Union, arguably the region in the world with the strictest MRL (Maximum Residue Level) regulations in food products. Since September 2008 the European Food Safety Authority (EFSA) regulates the MRL for each agrochemical in every crop for all EU countries. Therefore, if you are a produce grower exporting to an EU country, complying with these standards may get you through customs, but will not necessarily open the door to your destination market. Some large supermarket chains in the EU apply their own, often more stringent MRL requirements to their produce suppliers, both domestic and foreign.

Good examples of the European retail private standards in pesticide residue and other food safety requirements are Tesco's "Nature's Choice," M&S's "Field to Fork," and Sainsbury's "Residue Free" in the UK. A number of German retailers, including Tengelman and Rewe will only accept produce with 70% or less of the legal MRLs, and in the Dutch sector, Aldi and Lidl as well as Super de Boer have also introduced their own MRLs. [roretail.com].

Some of these corporations lead by The Edeka Group, one of Germany's largest retail organizations, and includ-

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ing UK's M&S and Co-op, went even farther when they started prohibiting the use by its suppliers of dozens of pesticides, whether those chemicals were officially banned or not in their countries of operation. [foe.co.uk]

Bruce Kirkpatrick, director of Global Marketing for Valent BioSciences Corp., sees this movement as "a significant market driver that will continue to grow. It directly impacts production within the EU and also for exporters from around the world selling into the EU. Biopesticides, when used as part of a season-long pest control program with chemical pesticides, can play a significant role in helping growers manage their residue levels to meet these more stringent requirements. U.S. produce retailers are beginning to have an impact in this area and this is expected to increase in the future."

This strict measure responds to a global trend toward a more sustainable ag industry, where safer food products must be produced more efficiently, and with fewer resources. Thierry Merckling, managing director for Europe Middle-East Africa of AgraQuest says: "because the biopesticide industry is matching this trend, it will play a leading role in this ag revolution. Growers are going to apply changes in crop protection programs including biopesticides."

Merckling

In this vast shift to the production of even more environmentally sound products, Europe is the most aggressive. In 2008, the Ministry of Food, Agriculture and Fisheries in France launched the program "Ecophyto 2018," (see sidebar) which it strives for a 50% reduction in the use of pesticides by 2018. According to the organization, "the most notable goal of the program is to reduce the dependency of farms on plant protection products, while at the same time maintaining agricultural production at a high level in both quality and quantity terms." [agriculture.gouv.fr/ecophyto-2018]

Other initiatives such as the Danish government's "Green Growth" agreement include financial support for alternative plant protection products. The government has set aside $2.3 million for the 2011-2015 period to assist applicants seeking authorization for placing their alternative plant protection products in Denmark on the market. [mst.dk/English/PesticidesAndGeneTechnology/Pesticides/Grant+Programmes/alternativePPP/]

A Solution, not a Replacement

European countries are setting the trend toward zero-residue food products that only integrated solutions including biopesticides can produce. But, will biopesticides replace traditional products? Not at all, both Cary and Merckling agree.

"We introduce biopesticides with other products (chemicals with a good profile). One of the benefits of biopesticides is that these products provide new directions. On the contrary, when you use too much of the same product you create [pest] resistance and other problems," Cary says.

Merckling stresses the need to "think more in terms of programs instead of products, in strategies to grow these crops. There is still a need for more intelligence and experimentation about programs, but I've seen a change in the way advisors used to think."

There is no doubt that biopesticide companies view these changes as an opportunity that will drive market success and are adapting their business model to offer more value to the industry.

The proper use of biopesticides in crop production systems promotes sustainable agriculture, meets consumer demand in terms of healthier, residue-free food products, and avoids pest resistance problems, thus preserving other valuable chemistries. But many of the right conditions must be in place concurrently for this to happen.

In the European food supply chain sector, says IBMA's executive director, "everything is coming together at the right time to make it work. This sort of synchronization is not yet happening in other regions." According to Cary, when you have all the forces working in the same direction, it changes how one works in production systems — from the data recording to barrier treatments and appropriate seed varieties. "Then you choose products assuring there are no risks with environment and human health, not relying only on traditional chemicals. So your whole thinking has changed — you are using those tools where they fit in," Cary says.

"Everything is coming together at the right time."

Cary

How long before the world's largest retailers — and other U.S. based companies — set their own safety standards for fresh produce? Probably sooner rather than later. That's why growers, advisors, dealers, and buyers must be prepared to be in sync with what the world demands – larger quantities of safe, high quality, residue-free products. ■

Editor's note: Ana Isabel Reho is the Group Editor for Meister Media's Fruit and Vegetable Group.

FRANCE TAKES ACTION

As a follow up to "Ecophyto 2018," the French Minister of Agriculture has summarized the program into these four priority areas:

écophyto2018

1. to encourage growers to use biocontrol practices in crop protection
2. to promote innovation for the development of safe and effective innovative growing techniques
3. to support the marketing of biocontrol products
4. to better inform professionals and to follow up on the development of these uses.

[agriculture.gouv.fr/IMG/pdf/110420_Feuille_route_biocontrole-2.pdf]

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Agree® WG	*Bt aizawai*	Lepidoptera (caterpillar) pests	Yes	Yes	Yes	4 hrs.	0	3-14 days
CryMax® WDG	*Bt kurstaki* strain EG7841	Lepidoptera (caterpillar) pests	No	No	Yes	4 hrs.	0	3-14 days
Deliver®	*Bt kurstaki*	Lepidoptera (caterpillar) pests	Yes	Yes	Yes	4 hrs.	0	3-14 days
Javelin® WG	*Bt kurstaki*	Lepidoptera (caterpillar) pests	Yes	Yes	Yes	4 hrs.	0	3-14 days
Lepinox® WDG	*Bt kurstaki* strain EG7826	Lepidoptera (caterpillar) pests	No	No	Yes	4 hrs.	0	3-14 days
Bioinsecticides								
PFR-97™	*Paecilomyces fumosoroseus*	Aphids, whiteflies, thrips, mites, psyllids	No	No	No	0 hrs.	N/A	7-10 days
Insect Growth Regulators								
Neemazad® 1% EC	Azadirachtin	Leafminers, whiteflies, aphids	Yes	Yes	Yes	4 hrs.	0	3-21 days
Neemix® 4.5 EC	Azadirachtin	Leafminers, whiteflies, aphids	Yes	Yes	Yes	12 hrs.	0	3-21 days
Insecticidal Viruses								
CYD-X®	*Cydia pomonella* GV	Codling moth larvae	Yes	Yes	Yes	4 hrs.	0	7-14 days
Gemstar® LC	*Helicoverpa zea* NPV	Corn earworm larvae	Yes	Yes	Yes	4 hrs.	0	7-14 days
Spod-X®	*Spodoptera exigua* NPV	Beet armyworm larvae	Yes	Yes	Yes	4 hrs.	0	7-14 days
Insecticidal Soaps								
DES-X®	Potassium salts of fatty acids	Aphids, whiteflies	Yes	Yes	Yes	12 hrs.	0	7-21 days
Insecticidal Baits								
Bug-N-Sluggo®	Spinosad, Iron phosphate	Earwigs, cutworms, slugs, snails	No	Yes	Yes	4 hrs.	Varies	14-28 days
Seduce	Spinosad	Earwigs, cutworms	Yes	Yes	No	4 hrs.	Varies	14-28 days
Sluggo® (Eastern U.S. only)	Iron phosphate	Slugs, snails	Yes	Yes	Yes	0 hrs.	0	14-28 days
FUNGICIDES								
Biofungicides								
SoilGard®	*Gliocladium virens* GL-21	Damping off and other soil-borne diseases	Yes	Yes	Yes	0 hrs.	0	7-28 days
Trilogy®	Clarified hydrophobic extract of neem oil	Powdery mildew, rust, black spot	Yes	Yes	Yes	4 hrs.	0	7-14 days
Biochemicals								
Cueva™	Copper octanoate	Bacterial disorders, downy mildew, powdery mildew	Yes	Yes	Yes	4 hrs.	0	7-10 days
Sil-MATRIX®	Potassium silicate	Powdery mildew, Botrytis, mites, aphids	Yes	Yes	Yes	4 hrs.	0	7-10 days
MITICIDES								
Miticides (Acaricides)								
Trilogy®	Clarified hydrophobic extract of neem oil	Spider mites, broad mites, rust mites	Yes	Yes	Yes	4 hrs.	0	7-21 days
Sil-MATRIX®	Potassium silicate	Mites	Yes	Yes	Yes	4 hrs.	0	7-10 days
NEMATICIDES								
Bionematicides								
MeloCon® WDG	*Paecilomyces lilacinus*	Plant parasitic nematodes, including root knot, burrowing, cyst, root lesion, false root knot and sting nematodes	Yes	Yes	Yes	4 hrs.	0	6 weeks
HERBICIDES								
Final-San-O™	Ammoniated soap of fatty acids	Grasses and broadleaf weeds	Yes**	Yes	Yes	24 hrs.	0	14-21 days
ABIOTIC STRESS MANAGEMENT								
SCREEN™ Duo	Enhanced kaolin blend	Heat stress and sunburn management	No	No	Yes	0 hrs.	0	7-14 days
TRADITIONAL CHEMISTRY								
Soil Fumigants								
Basamid® G	Dazomet	Weeds, nematodes, grasses, soil-borne diseases	No	No	No	24 hrs.	N/A	N/A

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